Profiling High Numeracy Achievement

The PROFILING HIGH NUMERACY ACHIEVEMENT PROJECT TEAM report on the South Australian Department of Education and Children's Services numeracy project. The research sought to identify whole-school structures and effective teaching practices that support improved numeracy outcomes.

Profiling high numeracy achievement is the South Australian Department of Education and Children's Services component of the Australian Government funded Strategic Numeracy Research and Development Initiative. The South Australian project was managed collaboratively by the South Australian Primary Principals' Association and the Learning Outcomes and Curriculum Group. The Flinders Institute for the Study of Teaching conducted the research component of the project. The project investigated factors enabling students to become high numeracy performers. It aimed to identify whole-school structures and effective teaching practices that support improved numeracy outcomes and to develop a coordinated and strategic plan for numeracy improvement at the system, school and classroom level. It was guided by the following research questions of schools that had consistently shown improvement in numeracy results for individual students:

1. What are the variables that impact on numeracy learning?
2. What teaching practices and school programs support improved numeracy outcomes?

It also sought to:

- identify, through the use of surveys, interviews and observations, effective whole-school structures and practices that support improved numeracy outcomes;
- identify effective teaching and learning strategies to support improved learning outcomes for students in the area of numeracy;
- develop a profile to support high numeracy performance based on the data gathered; and
- support the trial and subsequent improvement of this profile in other school settings.

The intended outcomes of the research were:

- the development of a profile of numeracy achievement in the early years of schooling that could be developed, validated and made available to all schools as a resource; and

- the improvement of numeracy achievements and attitudes for students in reception to Year 7 in the Phase 1 schools and Phase 2 schools through the use of the profile.

Methodology

The research methodology involved both qualitative and quantitative methods. The collection of Basic Skills Test (BST) data was used, in part, to identify schools participating in the project and to determine whether students' numeracy had improved after using the profile. Students' progress and overall school improvement was examined in terms of an analysis of BST pre- and post-tests, through comparisons with State wide growth in numeracy. The project research team used three main audits to determine the state of numeracy development in each project school.

Development of a profile

The profile, which is available online at the South Australian Literacy and Numeracy network at www.thenetwork.sa.edu.au, is the main product of the project and is a valuable resource for school and site leaders, personnel with lead responsibility for numeracy and classroom teachers.

The development of the profile involved an initial investigation into numeracy practices in four schools (designated Phase 1 schools) identified as achieving significant and consistent improvement in numeracy and that had a demonstrable whole school commitment to improving students' numeracy outcomes. The resulting draft profile was field tested in nine schools (designated Phase 2 schools) that had shown a commitment to improving students' numeracy outcomes and had the whole school structures and leadership to support change. The draft profile was then trialled in nine Phase 2 schools using an action research model that allowed teachers to work on significant numeracy issues arising from their own school contexts. For the period of the research (approximately ten weeks), each school chose to concentrate classroom learning on one of the five strands in the South Australian Community Standards and Accountability (SACSA) Framework mathematics learning area. The intention was that teachers would experiment with new approaches to numeracy in the chosen strand, and that an attempt would be made to determine how their knowledge and attitudes had changed over the time of the research.

The profile incorporates a whole-school approach to numeracy improvement based on the inter-related elements of structural, cultural and pedagogical (teaching practice) change.

The profile

The major elements identified under *restructuring* include:

- the importance of a school commitment to numeracy improvement;
- a theory of whole-school reform that is adaptable to the needs of individual schools;
- dedicated time for curriculum development and professional development for staff;
- allocated time for mathematics in the timetable; and
- forums for parents to engage in educative dialogues about numeracy and numeracy development.

The major elements identified under *reculturing* (changing the culture of schools) include:

- confronting mathematics anxiety;
- understanding the relationship between mathematics and numeracy;
- encouraging students to take responsibility for and to make decisions about their numeracy learning;
- the use of data concerning student knowledge, attitudes and understandings; and
- the significance of pedagogical leadership in promoting numeracy as a school priority.

The *pedagogical* (teaching practice) elements include:

- enacting constructivist learning (i.e., based on the idea that children construct knowledge from their own experiences);
- connecting mathematics learning and everyday life;
- emphasising the transferability of learning;
- implementing assessment and reporting practices that promote learning;
- supporting students to be independent learners; and
- making the literacy of mathematics explicit.

Key findings

A key finding from this research is that more substantial and enduring changes to numeracy practices require a whole-school response to ensure an integrated and coherent approach to school planning, professional development and resource acquisition. In other words, cultural and structural changes are needed to support changes at the classroom level.

The main findings from the project also showed that many schools were struggling with the practices required to improve numeracy outcomes. Teacher and student attitude audits revealed a range of perceptions about mathematics and mathematics learning. While some of this information was positive, there were a number of issues raised that prompted changes in the schools. The teacher audit which gathered information about teachers' attitudes and knowledge of mathematics, both in terms of their own schooling experiences and as teachers of mathematics, found that many teachers are anxious about mathematics; that many have not

School structures and processes

- Does numeracy occupy a prominent position on the school's statement of purpose or partnership plan?
- Is it supported by leadership roles/responsibilities?
- What financial resources have been allocated to support improvement in numeracy across the school?
- What externally funded projects support school-based reforms in numeracy?
- What committee structures and planning processes facilitate teachers' professional development in this area? How will new teachers be inducted into the school's numeracy practices?
- Has the school created spaces and planning opportunities for teachers to develop curriculum?
- Has the school conducted:
  (a) audits of teachers'/students' attitudes towards mathematics?
  (b) audits of students' mathematical knowledge?
- How does the school evaluate and monitor improvements in numeracy:
  (a) across the school?
  (b) for particular groups of students, for example, students on negotiated curriculum plans, girls, Aboriginal students and those of non-English speaking backgrounds?
- What structures and processes enhance school/community dialogue about numeracy? How are parents involved in the school's numeracy program?

School culture

- How does the school foster a culture of collaboration?
- What does this look like with regards to school planning and team teaching?
- Who gets to be a leader in the school? Do teachers with special expertise and knowledge in the area of numeracy take on leadership roles?
- To what extent does the school promote a culture of debate about teaching and learning in the numeracy area?
- What are the signs of critically reflective practices in the school?

Pedagogy

- What view of numeracy informs curriculum development and teaching practices?
- How does the mathematics program articulate with this view of numeracy?
- What timetabling practices support mathematical studies/numeracy?
- How are students grouped?
- Do children get opportunities to make connections between mathematics and real life situations across the curriculum?
- What policies and strategies support students at risk?
- How do teachers assess and report on students' achievements? What value is attached to:
  (a) standardised testing?
  (b) teacher judgements?
- Are children given opportunities to take risks; to work collaboratively; to negotiate the curriculum; to integrate numeracy skills?
- Where's the evidence of transferability and improvements in numeracy outcomes?
- How does the school cater for individual difference?
- Does the school promote critical literacies and critical numeracies? What does this look like in practice?

Figure 1. School numeracy audit tool.

had much professional development in the area; and that teachers are generally less confident about numeracy than literacy. A major issue for teachers was how to transfer mathematical learning to other curriculum areas and how to promote approaches towards constructivist learning in mathematics. Using a constructivist approach requires teachers to create learning situations where students use their previous learning to build and develop their understanding of mathematics and numeracy concepts.

The audits of students' attitudes towards mathematics show that many have limited ideas of what is involved in numeracy and mathematics and how this connects with their everyday lives. The research also shows that a great deal of work needs to be done to improve students' knowledge and understanding of mathematical ideas and concepts as part of improving numeracy outcomes.

The research confirms the need for greater commitment by schools and education systems to support the professional development of teachers in numeracy. Improving numeracy achievement for all depends on teachers having access to appropriate resources to advance their own mathematical knowledge and understandings of the practices that enhance numeracy improvement in schools. The development of a profile to inform their teaching practice is an important step to assist them in this task.

Numeracy outcomes audit

The research team developed and used a whole-school numeracy audit tool (see Figure 1) in the project. This may be a useful starting point for a whole school approach to numeracy improvement. Such an audit might begin with the question: How do current school structure, culture and teaching practices, support or inhibit numeracy improvement for all students?

Further research

As indicated in the key findings in the project that showed that many schools are struggling over the practices required to improve numeracy outcomes, further research needs to examine:

- supplementing methods of assessing and reporting on numeracy outcomes across the school curriculum; and
- ways of promoting critical numeracies in schools, that support teachers to develop students' abilities to question ways that mathematical information is presented and used to influence them in every day situations.

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